

CLAIMS

1. A method for decoding and displaying MPEG pictures in a rewind speed mode, the method comprising:

receiving a stream of picture data compressed according to a MPEG standard using a specified number N of frame memories, wherein each of the memories are adapted for storing a decoded picture, and wherein N is an integer greater than 3;

allocating frame memories when one of the frame memories is to be overwritten so as to permit storage of a new picture to be decoded as follows;

overwriting based on a priority, a frame memory a picture which has already been displayed and which is no longer required for performing a next picture decoding;

overwriting based on a priority, a frame memory, in which a picture which exhibits a minimum decoding cost is stored;

not overwriting a frame memory, in which a picture which is currently being displayed is stored;

not overwriting a frame memory, in which a picture which is ready for display but has not yet been displayed is stored; and

not overwriting a frame memory, in which a reference picture required for decoding of a new picture to be decoded is stored;

wherein if no frame memory as allocated above can be overwritten, then suspending the decoding until a picture is displayed and the frame memories are re-allocated as after this display as characterized above.

2. The method according to claim 1, wherein the stream of picture data includes predicted pictures comprising type I pictures and type P pictures;

wherein the type I pictures exhibit a first specified decoding cost;

wherein the type P pictures predicted from a type I picture exhibit a second decoding cost, greater than the first decoding cost; and

wherein the type P pictures predicted from another type P picture exhibit a decoding cost greater than a decoding cost of an other type P picture.

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3. The method according to claim 2, wherein the stream of picture data includes predicted pictures comprising type B pictures and wherein the type B pictures exhibit the first decoding cost.
4. The method according to claim 1, wherein a check is carried out to verify whether a new picture to be decoded is not already stored in any one of the frame memories before decoding the new picture.
5. The method according to claim 1, further comprising:
 - determining at each picture display synchronization event whether a picture which is ready for display is present in one of the frame memories;
 - if the picture which is ready for display is present in one of the frame memories then displaying the picture and marking it as obsolete if the picture is no longer required in order to perform a picture decoding; and
 - if the picture which is ready for display is not present in one of the frame memories then repeating the displaying of a picture displayed at a previous picture display synchronization event.
6. The method according to claim 1, wherein the receiving a stream of picture data compressed according to a MPEG standard includes reading portions from a mass storage digital medium, in response to a rewind mode read command.

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7. The method according to claim 1, further comprising:
- a) loading a portion of the stream into a buffer memory;
 - b) analysing a portion of the stream so as to identify an access point of a decodable group of pictures and to determine at least for each of the pictures of the group, information including an address of the picture in the buffer memory, a presentation time stamp associated with an order of forward display of the picture, and one of a type I picture, type P picture, and type B picture, and storing the information in an indexation table;
 - c) obtaining an enhanced indexation table by supplementing the indexation table obtained in step b by specifying for each picture of type P picture and type B picture each one or more pictures referenced;
 - d) determining, from the indexation table, for a next picture to be displayed, a reconstruction list which is an ordered list of the reference pictures to be decoded sequentially onwards of the access point so as to obtain a next picture to be displayed; and
 - e) obtaining, from the reconstruction list, the next picture to be displayed by decoding one or more of the pictures of the reconstruction list.
8. The method according to claim 7, further comprising between step b) and step c), the following:
- allocating to each of picture in a first portion of the stream a unique identification number enabling the picture to be identified in the stream.
9. The method according to claim 8, wherein in step d), the next picture to be displayed is determined from the unique identification number.

10. The method according to claim 7, further comprising:
verifying, to obtain the next picture to be displayed, whether at least one of the pictures of the reconstruction list associated with the next picture to be displayed is not already stored in one of the frame memories, and if the next picture to be displayed is not already stored in one of the frame memories then a sequential decoding of the pictures of the list is commenced not from the access point of a decodable group of pictures but from a picture stored in the frame memories.
11. The method according to claim 7, further comprising:
calculating a delay, with respect to a theoretical display speed, each time a picture is displayed, and wherein step d), the next picture to be displayed is determined in such a way as to cancel the delay by skipping pictures, as follows:
skipping one or more B type pictures by priority;
wherein if one or more skips of B type pictures is not sufficient to cancel the delay, then one or more P pictures are skipped;
wherein if one or more skips of P pictures are not sufficient to cancel the delay, then one or more portions of the data stream are skipped during the loading, in step a), of a next portion of the data stream into the buffer memory.
12. The method according to claim 7, wherein the buffer memory comprises a first memory bank and a second memory bank, and in that steps d) and e) are carried out in the first memory bank of the buffer memory for a first portion of the stream, while steps a) to c) are carried out in the second memory bank of the buffer memory for a second portion of the stream.
13. The method according to claim 12, wherein at least one of the first memory bank and the second memory bank is not overwritten in step a) as long as the data therein is still required for the processing of the data contained in the other of the first memory bank and the second memory bank.

14. The method according to claim 12, further comprising:
overwriting one of the first and second memory banks with a new portion of the stream in step a), as soon as the data therein is no longer required for the processing of the data contained in the other of the first memory bank and the second memory bank.
15. The method according to claim 12, wherein portions of the stream loaded into the first memory bank and into the second memory bank overlap, so as to form a join between the portions loaded in the first memory bank and the second memory bank is made at a level of a common picture.
16. The method according to claim 12, wherein the indexation tables relating to portions of the stream portions loaded into the first memory bank and into the second memory bank constitute a single indexation table.

17. A playback device for decoding and for displaying MPEG picture in a rewind mode, the device comprising:

an input for receiving a stream of picture data compressed according to a MPEG standard using a specified number N of frame memories, wherein each of the memories are adapted for storing a decoded picture, and wherein N is an integer greater than 3;

a means for allocating the frame memories when one of the frame memories is to be overwritten so as to permit storage of a new picture to be decoded as follows;

a frame memory in which a picture which has already been displayed and which is no longer required for performing a next picture decoding, is overwritten by priority;

a frame memory, in which a picture which exhibits a minimum decoding cost is stored, is overwritten by priority;

a frame memory, in which a picture which is currently being displayed is stored, cannot be overwritten;

a frame memory, in which a picture which is ready for display but has not yet been displayed is stored, cannot be overwritten; and

a frame memory, in which a reference picture required for the decoding of the new picture to be decoded is stored, also cannot be overwritten;

wherein if no frame memory as allocated above can be overwritten, then suspending the decoding until a picture is displayed and the frame memories are re-allocated as characterized above.

18. The playback device according to claim 17, wherein the stream of picture data includes predicted pictures comprising type I pictures and type P pictures;

wherein the type I pictures exhibit a first specified decoding cost;

wherein the type P pictures predicted from a type I picture exhibit a second decoding cost, greater than the first decoding cost; and

wherein the type P pictures predicted from another type P picture exhibit a decoding cost greater than a decoding cost of an other type P picture.

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19. The playback device according to claim 18, wherein the stream of picture data includes predicted pictures comprising type B pictures and wherein the type B pictures exhibit the first decoding cost.

20. The playback device according to claim 17, further comprising:
means for verifying that a new picture to be decoded is not already stored in any one of the frame memories before decoding the new picture.

21. The playback device according to claim 17, further comprising:
means for determining at each picture display synchronization event whether a picture which is ready for display is present in the frame memories;
if the picture which is ready for display is present in one of the frame memories then displaying the picture and marking it as obsolete if the picture is no longer required in order to perform a picture decoding; and
if the picture which is ready for display is not present in one of the frame memories then repeating the displaying of a picture displayed at a previous picture display synchronization event.

22. The playback device according to claim 17, wherein the means for receiving a stream of picture data compressed according to a MPEG standard includes reading portions from a mass storage digital medium, in response to a rewind mode read command.

23. The playback device according to claim 17, further comprising:
- a) means for loading a portion of the stream into a buffer memory;
 - b) means for analysing the portion of the stream so as to identify an access point of a decodable group of pictures and to determine at least for each of the pictures of the group, information including an address of the picture in the buffer memory, a presentation time stamp associated with an order of forward display of the picture, and one of a type I picture, type P picture P, and type B picture, and storing the information in an indexation table;
 - c) means for obtaining an enhanced indexation table by supplementing the indexation table obtained in step b by specifying for each picture of type P picture and type B picture each one or more pictures referenced;
 - d) means for determining from the indexation table, for a next picture to be displayed, a reconstruction list which is an ordered list of the reference pictures to be decoded sequentially onwards of the access point so as to obtain the next picture to be displayed;
 - e) means for obtaining from the reconstruction list, the next picture to be displayed by decoding one or more of the pictures of the reconstruction list.
24. The playback device according to claim 23, further comprising:
- means for allocating a unique identification number to each of picture according to an order of display of the pictures.
25. The device according to claim 24, wherein the means for determining the next picture to be displayed from the unique identification number.
26. The device according to claim 23, further comprising:
- means for verifying, to obtain the next picture to be displayed, whether at least one of the pictures of the reconstruction list associated with the next picture to be displayed is not already stored in one of the frame memories, and if the next picture to be displayed is not already stored in one of the frame memories then a sequential decoding of the pictures of the list is commenced not from the access point of a decodable group of pictures but from a picture stored in the frame memories.

27. The playback device according to claim 23, further comprising calculating a delay, with respect to a theoretical display speed, each time a picture is displayed, and wherein step d), the next picture to be displayed is determined in such a way as to cancel the delay by skipping pictures, as follows:

skipping one or more B type pictures by priority;

wherein if one or more skips of B type pictures is not sufficient to cancel the delay, then one or more P pictures are skipped;

wherein if one or more skips of P pictures are not sufficient to cancel the delay, then one or more portions of the data stream are skipped during the loading, in step a), of a next portion of the data stream into the buffer memory.

28. The playback device according to claim 23, wherein the buffer memory comprises a first and a second memory bank, and in that the means for changing and the means for analysing operate in the first memory bank of the buffer memory for a first portion of the stream, while the means for obtaining the indexation table, and the means for obtaining the next picture to be displayed operate in the second memory bank of the buffer memory for a second portion of the stream.

29. The playback device according to claim 28, further comprising:

means for preventing the overwriting of, any one of the first memory bank and the second memory bank as long as the data therein is still required for processing data contained in the other of the first memory bank and the second memory bank.

30. The playback device according to claim 28, further comprising:

means for overwriting one of the first and second memory banks with a new portion of the stream in step a), as soon as the data therein is no longer required for the processing of the data contained in the other of the first memory bank and the second memory bank.

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31. The device according to claim 28, wherein portions of the stream loaded into the first memory bank and into the second memory bank overlap, so as to form a join between these portions at the level of a common picture.
32. The device according to claim 28, further comprising:
means for combining into a single indexation table the indexation tables relating to each of portion of the stream loaded into the first memory bank and into the second memory bank.
33. The playback device according to claim 17, further comprising:
a video driver circuit.
34. The playback device according to claims 33, further comprising:
a decoder box.

35. A set-top box for decoding and for displaying MPEG picture in a rewind mode, the device comprising:

- a video driver circuit.

- an input for receiving a stream of picture data compressed according to a MPEG standard using a specified number N of frame memories, wherein each of the memories are adapted for storing a decoded picture, and wherein N is an integer greater than 3;

- a means for allocating the frame memories when one of the frame memories is to be overwritten so as to permit storage of a new picture to be decoded as follows;

- a frame memory in which a picture which has already been displayed and which is no longer required for performing a next picture decoding, is overwritten by priority;

- a frame memory, in which a picture which exhibits a minimum decoding cost is stored, is overwritten by priority;

- a frame memory, in which a picture which is currently being displayed is stored, cannot be overwritten;

- a frame memory, in which a picture which is ready for display but has not yet been displayed is stored, cannot be overwritten; and

- a frame memory, in which a reference picture required for the decoding of the new picture to be decoded is stored, also cannot be overwritten;

wherein if no frame memory as allocated above can be overwritten, then suspending the decoding until a picture is displayed and the frame memories are re-allocated as characterized above.